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ABSTRACT:

CHG DATE=19990617 STATUS=O> A circuit part e.g. a multipole connector comprises an integral member (A) obtained by fitting together a first (1) and a second (5) injection molded member, member (1) being capable of being plated., The first injection molded member has protuberances (3) for a conductor pattern formed on its fitted surface. The second injection molded member has substantially the same shape and sectional profile as the first injection molded member except complementary portions to the protuberances. The integral member is completed by conductor pattern formed by the top surface (3a) of the protuberance or protuberances of the first injection molded member by subjecting the integral member to a plating process. A circuit pattern can be formed on a circuit part constituting a comparatively simple circuit easily and at a low cost. Through holes (4) may be formed through the protuberances (3) and plated during the plating process. <IMAGE>

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U1S S2067

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(54) **Circuit parts including conductor patterns on moulded bases**

(57) A circuit part e.g. a multipole connector comprises an integral member (A) obtained by fitting together a first (1) and a second (5) injection molded member, member (1) being capable of being plated., The first injection molded member has protuberances (3) for a conductor pattern formed on its fitted surface. The second injection molded member has substantially the same shape and sectional profile as the first injection molded member except complementary portions to the protuberances. The integral member is completed by conductor pattern formed by the top surface (3a) of the protuberance or protuberances of the first injection molded member by subjecting the integral member to a plating process.

A circuit pattern can be formed on a circuit part constituting a comparatively simple circuit easily and at a low cost.

Through holes (4) may be formed through the protuberances (3) and plated during the plating process.

FIG. 1

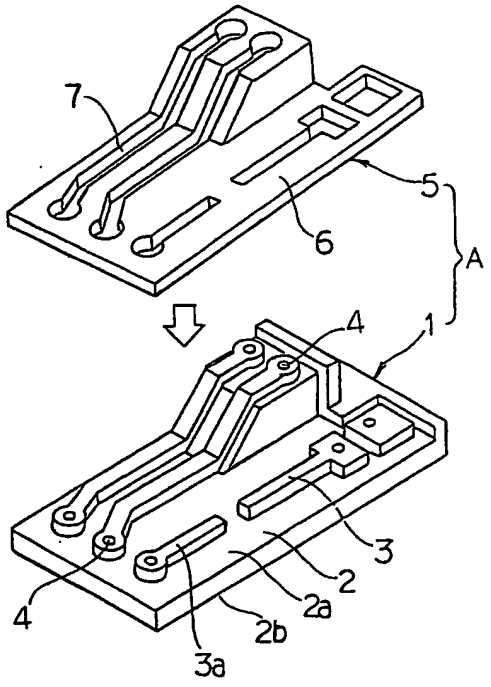

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FIG. 1

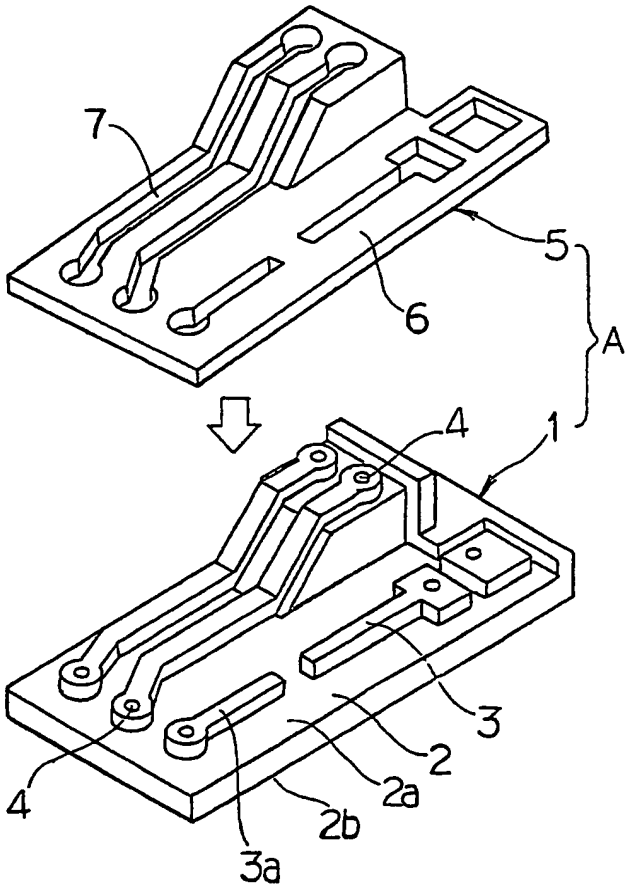


FIG. 2

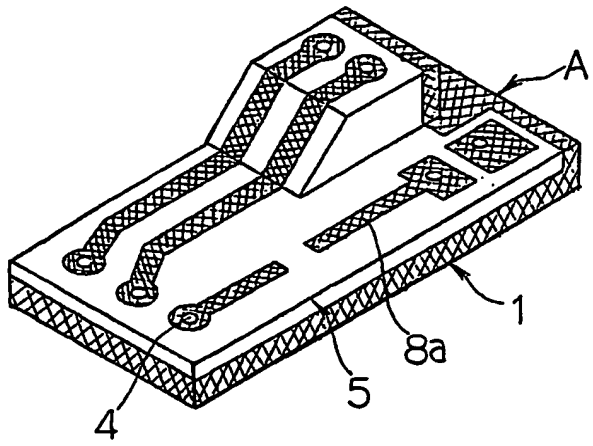


FIG.3

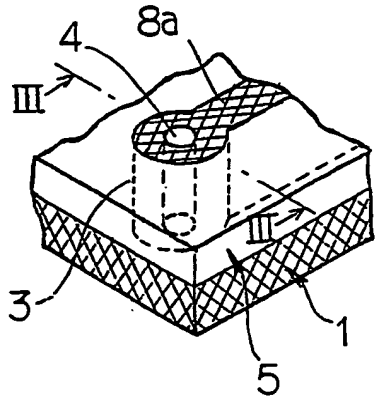


FIG.4

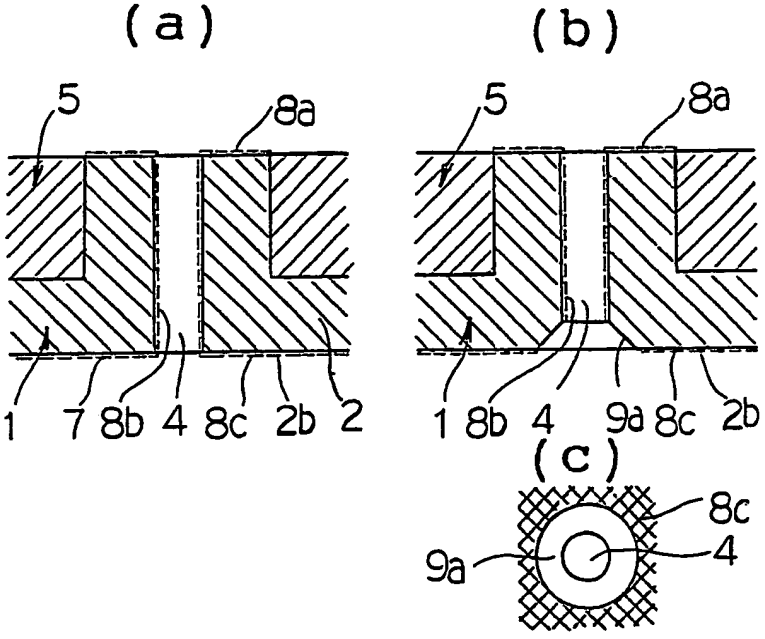


FIG. 5

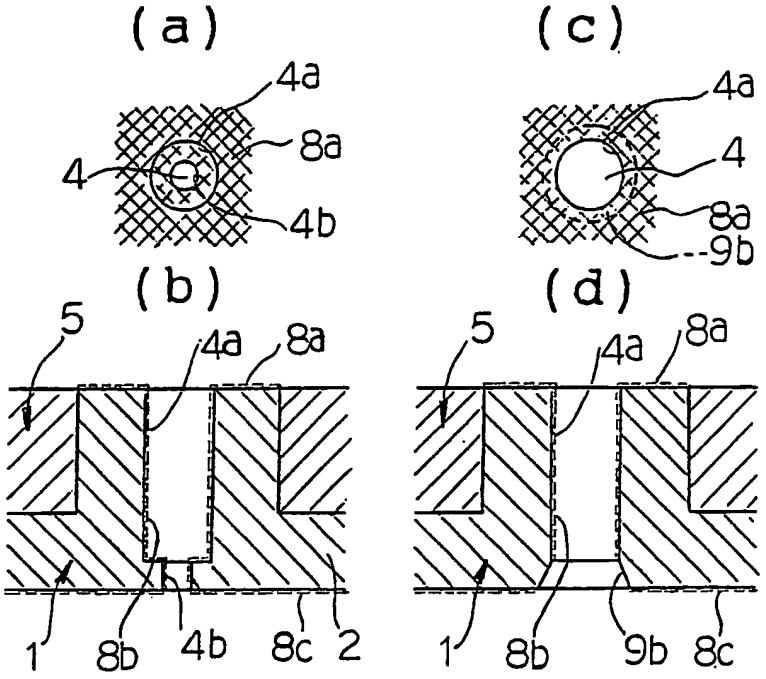

(a)
4a
8a
4
4b
(c)
4a
4
8a
9b
(b)
5
4a
8a
1
8b
4b
8c
2
(d)
5
4a
8a
1
8b
9b
8c

FIG. 6

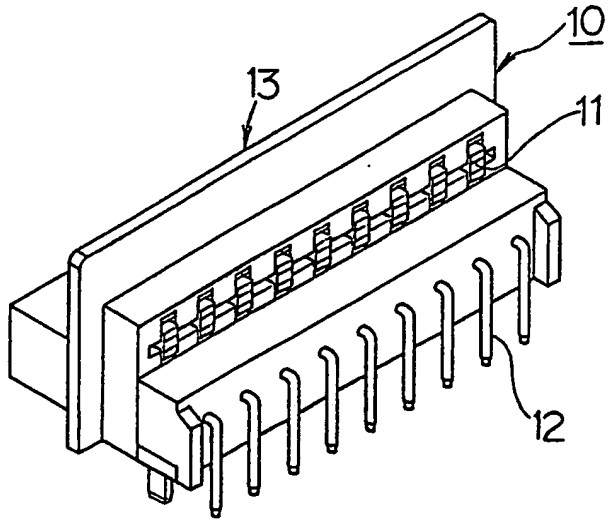

10
13
11
12

FIG. 7

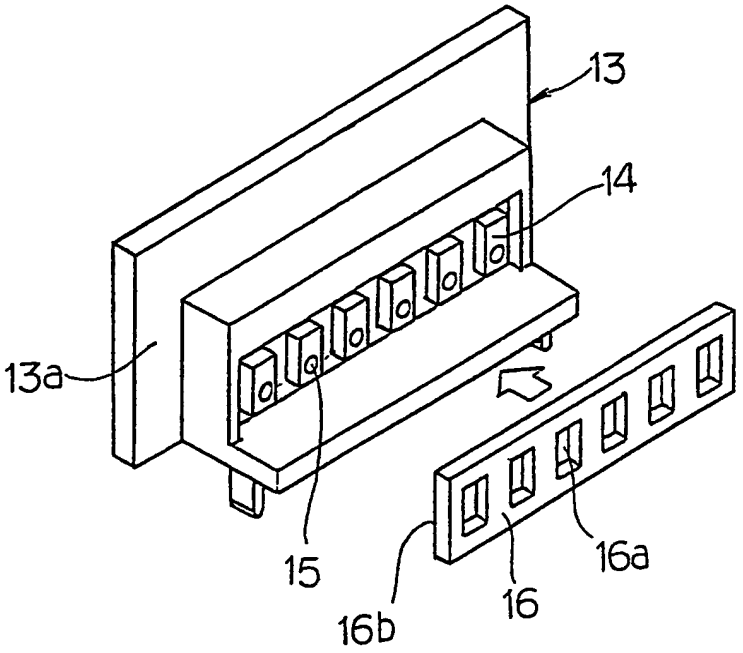


FIG. 8

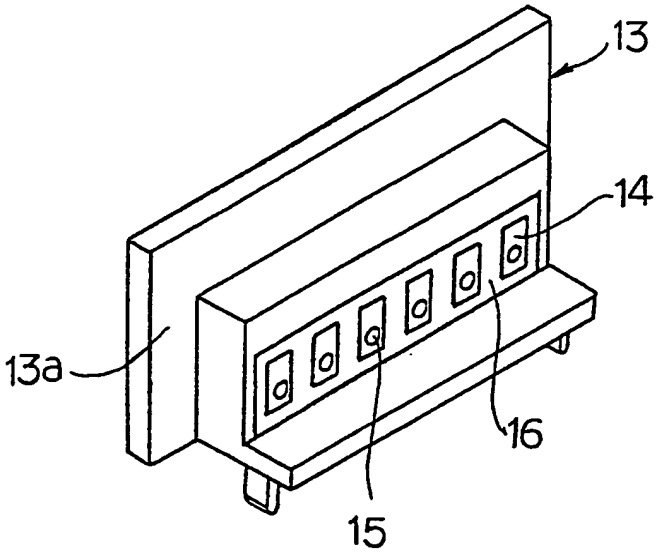


FIG. 9

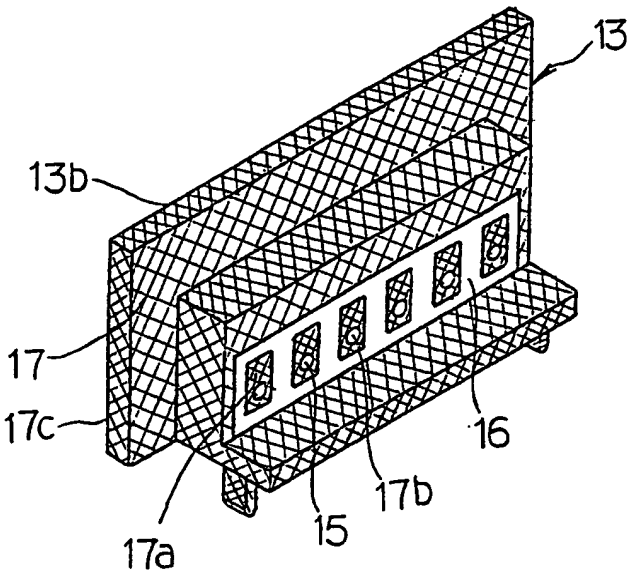


FIG. 10

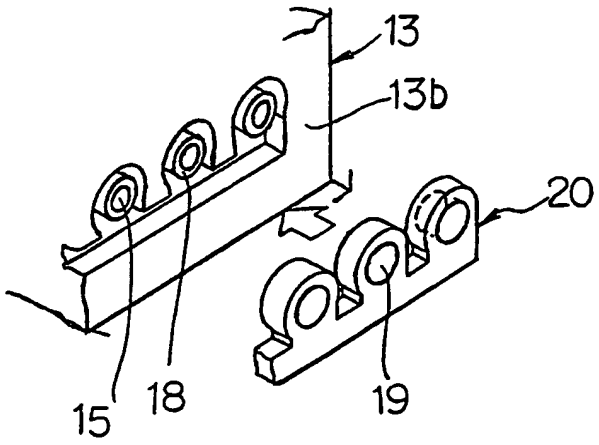
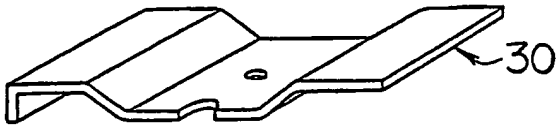
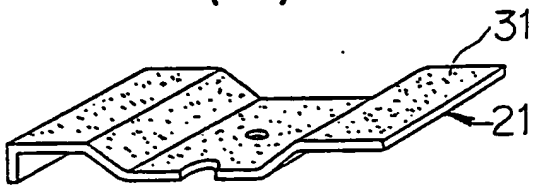


FIG. 11

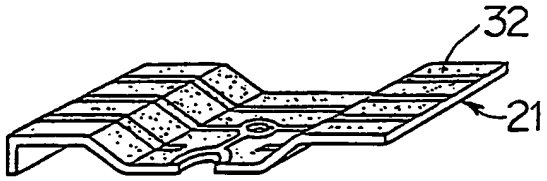
(a)



(b)



(c)



(d)

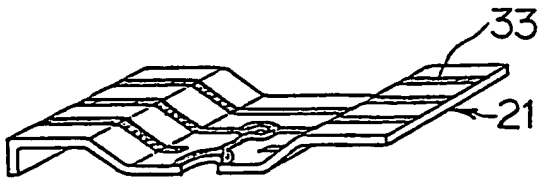
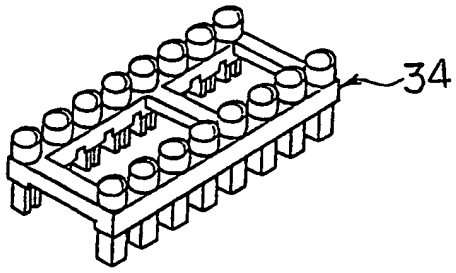
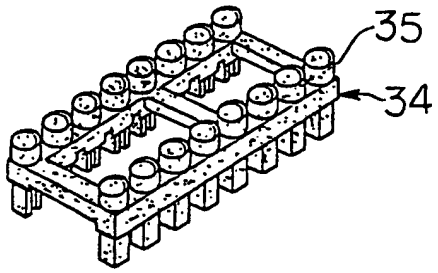


FIG. 12

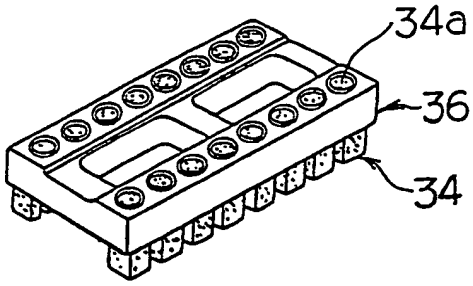
(a)



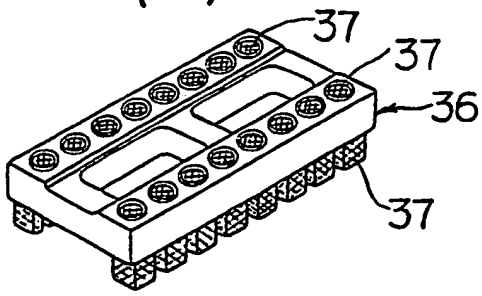
(b)



(c)



(d)



CIRCUIT PART AND METHOD OF MANUFACTURING THE SAME

This invention relates to circuit parts, in which a circuit pattern is formed on an injection-molded patter, and a method of manufacturing the same.

In the prior art, there are injection-molded circuit parts made of high performance engineering plastics or the like. Such injection-molded circuit parts have circuit patterns, which are formed mostly by one of two typical processes. One of the typical processes is a one-shot molding process, as shown in Fig. 11. In this case, in a first step (a) a substantially plate-like base or substrate 30 is formed by injection molding of a material, which is a highly heat-resistant resin capable of withstanding the high temperature of soldering. Then, in a step (b) the surface of the base 30 is subjected to such a pre-treatment as an etching or catalytic treatment and then is provided entirely with a non-electrolytic copper plating 31. Then, In a step (c) a masking 32 is formed using a masking or etching resist. Then, in a step (d) the entire surface is electrically plated. Thereafter, removal of resist on unnecessary portions and etching of copper are effected, thus forming a predetermined circuit pattern on the surface

of the substrate 30.

The other typical process of circuit formation is a two-shot molding process as shown in Fig. 12. In this case, in a step (a) a primary side molded part having a desired shape is formed. Then, in a step (b) a pre-treatment such as an etching or catalytic treatment is provided as shown at 35. Then, in a step (c) the resultant primary side molded part 34 is set in a die, and a secondary side material 36 is poured from above, thus forming a double-layer structure with the secondary side material 36 covering the primary side molded part 34 and exposing predetermined portions 34a thereof. Then, in a step (d) a metal film 37 is formed by plating on only the exposed predetermined portions 34a of the primary side molded part 34.

The one-shot molding process as shown above, however, involves many steps. In addition, the etching of copper is required, thus leading to high cost. Further, since the masking step is involved, an extra corner treatment is necessary. This is undesired from the standpoint of the operation control. Further, it is difficult to form a three-dimensional structure because of various limitations; for instance, the rising angle on the molded part surface should be within about 60 degrees, and the level step

should be within about 8 mm.

The two-shot molding process, on the other hand, is suited for the formation of three-dimensional circuits. However, since this process is a double-layer structure formation process, difficulty is involved in the aligning of the primary side molded part 25 in the die, and therefore the operational efficiency is inferior. In addition, since the process is based on non-electrolytic plating, it inevitably leads to high cost.

An object of the invention, which is intended in order to solve the above problems inherent in the prior art, is to permit formation of a circuit pattern of a circuit part constituting a comparatively simple circuit easily and at a low cost.

To attain the above object of the invention, there is provided a circuit part, which comprises a first injection molded member having one or more protuberances formed on on surface for a conductor pattern, the first injection molded member being capable of being plated, a second injection molded member having substantially the same shape and sectional profile as the first injection molded member except complementary portion or portions to the

protuberance or protuberances, the second injection molded member being capable of being plated, the first and second injection molded members being fitted together to obtain an integral member, and a conductor pattern formed by the top surface of the protuberance or protuberances of the first injection molded member by subjecting the integral member to a plating process.

According to the invention, there is also provided a method of manufacturing a circuit part, which comprises the steps of fitting, on a surface of a first injection molded member having one or more protuberances formed on the afore-mentioned surface for a conductor pattern, the first injection molded member being capable of being plated, a second injection molded member having substantially the same shape and sectional profile as the first injection molded member except complementary portion or portions to the protuberance or protuberances, the second injection molded member being capable of being plated, to obtain an integral member, and forming a conductor pattern on only the top surface of the protuberance or protuberances of the first injection molded member by subjecting the integral member as a whole to a plating process.

According to the invention, there is further provided a method of manufacturing a circuit part, which comprises

the steps of fitting, on a surface of a first injection molded member having one or more protuberances formed on the surface for a conductor pattern, the protuberance or protuberances each having a through hole, the first injection molded member being capable of being plated, a second injection molded member having substantially the same shape and sectional profile as the first injection molded member except complementary portion or portions to the protuberance or protuberances, the second injection molded member being capable of being plated, to obtain an integral member, and then forming a conductor pattern on an exposed surface or exposed surfaces of the first injection molded member by subjecting the integral member as a whole to a non-electrolytic plating process and then to an electric plating process.

According to the invention, there is still further provided a method of manufacting a circuit pattern, in which on the side of the second injection molded member opposite the fitted side material around the through hole or holes is removed to form an insulating section or insulating sections.

Embodiments of the present invention will now be described with reference to the accompanying drawings, of which:

Fig. 1 is an exploded perspective view showing constituent members of an embodiment of the circuit part

according to the invention;

Fig. 2 is a perspective view showing a circuit part formed by a method embodying the invention;

Fig. 3 is a fragmentary enlarged-scale perspective view showing the same circuit part;

Fig. 4 is a sectional view taken along line III-III in Fig. 3;

Fig. 5 is a view similar to Fig. 4 but showing a different embodiment of the invention;

Fig. 6 is a perspective view showing a multiple hole connector in the prior art;

Fig. 7 is a first explanatory view for explaining the formation of the multiple pole connector shown in Fig. 6 by the method according to the invention;

Fig. 8 is a second explanatory view for explaining the formation of the multiple pole connector shown in Fig. 6 by the method according to the invention;

Fig. 9 is a perspective view showing the multiple pole connector shown in Fig. 6, which is formed by the method according to the invention;

Fig. 10 is a perspective view showing a further embodiment of the circuit part according to the invention;

Fig. 11 is a view for explaining a prior art one-shot molding process; and

Fig. 12 is a view for explaining a prior art two-shot molding process.

Now, preferred embodiments of the invention will be described in detail with reference to Figs. 1 to 9. Fig. 1 is an exploded perspective view showing constituent members of a circuit part according to the invention, Fig. 2 is a perspective view showing a circuit part formed by a method embodying the invention; Fig. 3 is a fragmentary enlarged-scale perspective view showing the same circuit part, Fig. 4 is a view for explaining the part shown in Fig. 3, (a) being a sectional view taken along line III-III in Fig. 3 and showing the part before a processing thereof, (b) being a view similar to (a) but showing the part after the processing thereof, and (c) being the bottom view of the part shown in (b), Fig. 5 is similar to Fig. 4 but showing a different embodiment of the invention, (a) being a plan view showing the part before a processing thereof, (b) being a sectional view showing the same part, (c) being a plan view showing the part after the processing thereof, and (d) being a plan view showing the same part, Fig. 6 is a perspective view showing a prior art multiple pole connector, Figs. 7 to 9 are views for explaining the

formation of the multiple connector shown in Fig. 6 by the method according to the invention, and Fig. 10 is a fragmentary perspective view showing a different embodiment of the circuit part according to the invention.

Referring to Figs. 1 to 4, designated at 1 is a first injection molded member. The part 1 is made of polyether imide (PEI) or like highly heat-resistant resin capable of withstanding the temperature of soldering. The top surface 2a of its base or substrate 2 is formed with a plurality of ridges 3 having the same shape as a circuit pattern to be formed. Designated at 4 are through holes formed in opposite end portions of the ridges 3. The through holes 4 penetrate the base 2 from the top 2a to the bottom 2b. When the first injection molded member 1 is formed from a resin containing a plating catalyst, it is used without any plating pre-treatment. When it is formed from a usual highly heat-resistant resin, its entire surface is subjected to such a plating pre-treatment as an etching or catalytic treatment.

Designated at 5 is a second injection molded member formed from a highly heat-resistant resin, e.g., polyphenylene sulfide (PPS). The base or substrate 6 of the part 5 has the same shape and size as the first injection molded member 1 so that it can be snugly fitted

on the top 2a of the first injection molded member 1. The base 6 is formed with slits 7 to expose the surfaces 3a of the ridges 3 when it is fitted on the first injection molded member 1.

The first and second injection molded members 1 and 5 having the above structures are fitted and secured together to obtain an integral member A. The securement of the two injection molded members may be obtained by merely fitting them together. Depending on the shape, however, the two parts may be partly bonded together using an adhesive. The integral member A is then subjected to a non-electrolytic plating treatment to form a thin plating layer and then subjected to an electric plating treatment. Plating layers 8a to 8c are thus formed on the first injection molded member 1, i.e., the surfaces 3a of the ridges 3 exposed by the slits 7 of the second injection molded member 5, the surfaces of the through holes 4 and the bottom surface 2a, the plating layers 8a formed on the surfaces 3a of the ridges 3 constituting a circuit pattern. In this case, since the surfaces 3a of the ridge 3 and the bottom surface 2b are made continuous by the surfaces of the through holes 4, it is possible to obtain an electric plating treatment on the individual portions.

In this stage, as shown in (a) in Fig. 4, in the first

injection molded member 1 the plating layer 8a, formed on the surfaces 3a of the ridges 3, and the plating layer 8c, formed on the bottom surface 2b, are made continuous by the plating layer 8b, formed on the surfaces of the through holes 4. Therefore, on the side of the bottom surface 2b of the base 2 of the first injection molded member 1, a portion around each through hole 4 is chamfered to form an insulating section 9a as shown in (b) and (c) in Fig. 4. In this way, the circuit pattern 8a and the plating layer 8c on the bottom surface 2b of the base 2 are insulated from each other, and the plating layer 8c is grounded.

Shown in (a) and (b) in Fig. 5 is a case, in which each through hole 4 is a shoulder defined between a large and a small diameter portion 4a and 4b. In this case, as shown in (c) and (d) in Fig. 5, the material with the small diameter portion 4b of the through hole is broken apart using a die or like tool, thus forming an insulating section 9b insulating the circuit pattern 8a and the grounded section 8c on the bottom surface 2 of the base 2.

Fig. 6 shows an embodiment of the invention applied to a prior art multiple pole connector 10 provided with a noise removal filter. More specifically, in a connector with a filter, in which a chip capacitor 11 is mounted, a conductor pattern connecting connector pins 12 and the chip

capacitor 11 may be easily formed according to the invention. In Fig. 7, designated at 13 is a shield case of a resin. The shield case 13 has its front surface 13a formed with protuberances 14, which constiute a conductor pattern section. The protuberances 14 are each formed with a central through hole 14. The shield case 13 also has its front surface provided with a plating pre-treatment such as an etching or catalytic pre-treatment. Then, an insulating frame member 16, which has through holes 16a to be fitted on the protuberances 14 noted above and corresponds to the second injection molded member noted above, is fitted on the resultant shield case front surface 13a. At this time, the fitting surface 16b of the insulating frame member 16 may be bonded by coating an adhesive on it.

After the insulating frame member 16 has been made integral with the shield case 13, the entire system is subjected to a non-electrolytic plating treatment to form a thin plating layer. Then, the system is subjected to an electric plating treatment to form a player 17 on the entire surface of the shield case 13 except the surface covered by the insulating frame member 16, as shown in Fig. 9. In this embodiment, the conductor pattern section 17a and the shield section 17c are made continuous by the

plating layer 17b formed on the surfaces of the through holes 15 for inserting connector pins 12 therein. Therefore, like the previous embodiment, on the side of the back surface 13b of the shield case 13 opposite the side with the insulating frame member 16 fitted thereon material around the through holes 15 are chamfered to form insulating sections (not shown) insulating the conductor pattern section 17a and the shield section 17c from each other.

Fig. 10 shows a different method of forming the insulating section. In this case, on the side opposite the side with insulating frame 16 fitted thereon, annular protuberances 18 are formed such that each defines thorough hole 15. An insulating member 20 having holes 19 fitting the annular protuberances 18 is fitted on and secured to shield case 13, and the integral system thus obtained is subjected to a plating treatment. In this way, an insulating section is formed on the outer periphery of each annular protuberance 18, and thus it is possible to dispense with the chamfering step. In this case, however, the plating has to be done entirely by non-electrolytic plating, thus increasing the cost.

As has been described in the foregoing, with the structures according to the invention it is possible to

reduce the steps of production. In addition, since it is possible to adopt electric plating, the cost of production may be reduced. Further, it is possible to form three-dimensional circuit patterns.

It is to be noted that the aforegoing embodiments have been given by way of example only and a person skilled in that art will appreciate that modifications may be made without departing from the scope of the present invention.

CLAIMS:

1. A circuit part comprising a first injection molded member having one or more protuberances formed on one surface for a conductor pattern, said first injection molded member being capable of being plated, a second injection molded member having substantially the same shape and sectional profile as said first injection molded member except complementary portion or portions to said protuberance or protuberances, said second injection molded member being capable of being plated, said first and second injection molded members being fitted together to obtain an integral member, and a conductor pattern formed by the top surface of said protuberance or protuberances of said first injection molded member by subjecting said integral member to a plating process.

2. A method of manufacturing a circuit part comprising the steps of fitting, on a surface of a first injection molded member having one or more protuberances formed on said surface for a conductor pattern, said first injection molded member being capable of being plated, a second injection molded member having substantially the same shape and sectional profile as said first injection molded member except complementary portion or portions to said protuberance or protuberances, said second injection

molded member being capable of being plated, to obtain an integral member, and forming a conductor pattern on only the top surface of said protuberance or protuberances of said first injection molded member by subjecting said integral member as a whole to a plating process.

3. A method of manufacturing a circuit part comprising the steps of fitting, on a surface of a first injection molded member having one or more protuberances formed on said surface for a conductor pattern, said protuberance or protuberances each having a through hole, said first injection molded member being capable of being plated, a second injection molded member having substantially the same shape and sectional profile as said first injection molded member except complementary portion or portions to said protuberance or protuberances, said second injection molded member being capable of being plated, to obtain an integral member, and then forming a conductor pattern on an exposed surface or exposed surfaces of said first injection molded member by subjecting said integral member as a whole to a non-electrolytic plating process and then to an electric plating process.

4. A method of manufacturing a circuit part according to claim 3, wherein on the side of said second injection molded member opposite the fitted side material around said

through hole or holes is removed to form an insulating section or insulating sections.

5. A circuit part substantially as hereinbefore described with reference to any one of figures 1 to 10.

6. A method of manufacturing a circuit part substantially as hereinbefore described.